Buried Intake Structures: Design Features and Materials

Introduction

Buried intake structures provide the means to pump potable water from beneath surface water bodies or seawater from offshore or onshore sediments. A buried intake consists of one or more screens laid within in a trench that is backfilled with either selected gravel or native granular sediments.

This memorandum provides general information on the design and selection of appropriate types of screen materials for buried intakes. It does not include specific design calculations and design criteria. However, there is considerable published information available on these subjects in the references listed herein.

Design and Function

Buried intakes are set apart from other water supply facilities by the inherent simplicity of their design and ability to operate within special hydrogeologic settings. Characterized by their relative low cost, simple construction, and ease of maintenance, buried intakes are viable options to vertical wells, particularly when it is desirable to extract water from thin, shallow, permeable zones. In general, buried intakes are installed beneath surface water bodies because of water quality considerations or hydrologic fluctuations. For example, if the source water carries a high silt load, a buried intake provides filtering media; or if water levels fluctuate considerably in a lake or stream, a buried intake can tolerate such changes.

The scope of tasks for the design of a typical buried intake (backfilled with either gravel or natural materials) includes, but is not limited to, the following tasks:

- Calculate the permeability of the source aquifer. This can be obtained by a pumping test at a nearby vertical well. If such data are not available, permeability data for various types of sediments can be obtained from estimated values found in literature.
- Determine the permeability of any gravel to be used as backfill by laboratory testing.
- Calculate the estimated yield from the aquifer to the intake.
- Calculate the length of intake screen needed to yield the required volume of water for the facility.
- For streambed intakes, calculate the volume of water flowing beneath the bed of the stream, the yield of the intake, and the recoverable percentage of the underflow.

Screen Selection

The typical approach for selecting the type of screen for a buried intake is similar to conventional well design. Key attributes in material selection are durability, efficiency, and maintenance. Each of these should be addressed when selecting the type of steel that best meets the site-specific requirements and conditions. For durability, the screen's resistance to corrosion and its cost of maintenance are important. This is addressed in other Roscoe Moss Company technical memoranda (Nos. 004-2, 004-3, and 005-2).

Screen selection begins with the type of steel and the size of the slot opening. The amount of open area, number of slots, and diameter of the well screen are based on the entrance velocity and expected yield.

Materials. The two most common types of steel screens used to construct buried intakes are continuous wire-wrapped (CWW) screen and louvered screen. Both exhibit favorable hydraulic properties that minimize well losses and enhance efficiency. Therefore, for most applications, with proper attention to the formation gradation and backfill material, either should be suitable.

CWW screen and louvered screen are available in several types of steel:

CWW Screen	Louvered Screen
- Low carbon steel	- Low carbon steel
- Stainless steel	- Copper-bearing (CB) steel
	- High-strength, low-alloy (HSLA) steel
	- Stainless steel

CWW Screen. CWW screen manufactured from low carbon steel is a low-cost material that is prone to relatively rapid corrosion. It is generally not recommended because of its short useful life. A better selection would be Type 304 for stainless steel intakes. Intake screens installed in either brackish water or seawater should be manufactured from Type 316L stainless steel.

Louvered Screen. Louvered screen can be manufactured from low-carbon steel; however, it is less resistant to corrosion than other types of steel that are available. Studies have shown that copper-bearing steel, high-strength, low-alloy steel (HSLA), and stainless steel are more durable. Stainless steel (Types 304 or 316L) greatly extend lifetime and reduce the frequency of rehabilitation and maintenance costs (Clear Creek, 2003).

Slot Size. Flow of water from the aquifer into the buried intake should occur freely to minimize head loss. Therefore, the hydraulic properties of the well screen are important in the design process. One should select slot size by considering both the entrance velocity and the gradation of the backfill that envelopes the screen. If the screen is laid in a trench and backfilled with natural materials in the streambed or riverbank, the slot size should retain a high percentage of the backfill. If a gravel pack is needed to stabilize the aquifer, use standard practice for conventional wells to select the gradation.

Summary

Buried intake structures can be designed to supply potable water or seawater and are lower in cost than conventional water wells. They are simple and easily designed. As with conventional water wells, an important design consideration is the durability of the type of steel for the intake screen. Studies show that stainless steel is the most cost effective choice.

References

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